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# PATENT ABSTRACTS OF JAPAN

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(71)Applicant : DOWA MINING CO LTD

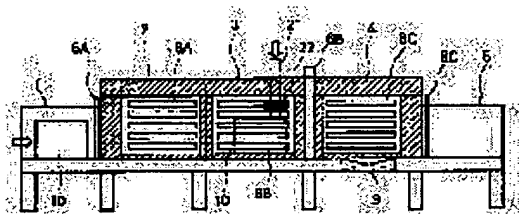
(72)Inventor : FURO MASAHIRO
KOSAKA MITSUTERU

## (54) MANUFACTURE OF METAL-CERAMIC COMPLEX MEMBER, MANUFACTURING APPARATUS AND MOLD FOR MANUFACTURING

(57)Abstract:

PROBLEM TO BE SOLVED: To increase the joining strength between a metal and a ceramic and to improve the quality.

SOLUTION: In a manufacturing apparatus of a metal-ceramic complex member, in which the metal is joined on the surface of the ceramic member by holding the ceramic member in a mold, pouring molten metal to be joined and cooling and solidifying, an atmosphere replacing part 1, in which oxygen concn. is made to a prescribed value or lower by replacing the atmosphere in the mold in the state of holding the ceramic member in the mold, a preheating part 2 for preheating the mold, a molten metal pouring part 3, in which the molten metal is poured into the mold while holding the temp. in the mold to the molten metal pouring temp., a cooling joining part 4, in which the metal is joined with the surface of the ceramic member by lowering the temp. in the mold to the joining temp. at the start of solidification of the molten metal and a slow cooling part 5 for slowly cooling the mold.



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CLAIMS

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[Claim(s)]
[Claim 1] A manufacture method of a metal-ceramic compound member which joins a metal to the surface of a ceramic member according to direct cementation force in a mutual interface of ceramics and a metal by pouring in and carrying out the cooling solidification of the molten metal of a metal which is characterized by providing the following, and which should hold a ceramic member in mold and should be joined into this mold so that the surface of said ceramic member may be contacted A mold ambient atmosphere substitute production process which replaces an ambient atmosphere in said mold and makes an oxygen density below a predetermined value where a ceramic member is held in said mold A preheating production process which heats said mold beforehand after this production process A teeming production process which maintains temperature in said mold to pouring temperature after this production process, and carries out teeming of the molten metal of said metal into this mold so that the inside of this mold may be filled A cementation production process which it lowers [ production process ] to virtual junction temperature with which a molten metal of said metal begins to solidify temperature in said mold, and a cementation operation is demonstrated after this production process, and joins a metal to the surface of said ceramic member, and an annealing production process which anneals said mold after this production process
[Claim 2] A manufacture method of a metal-ceramic compound member according to claim 1 characterized by supplying a metal molten metal after it performed teeming using what is characterized by providing the following and an oxide skin was removed by said joint by the narrow section A molten metal inlet which introduces a metal molten metal in this mold as said mold at said teeming production process The narrow section which removes an oxide skin formed in said metal molten metal surface in the middle of a path to [ while holding said ceramic member, has a joint which secures a predetermined opening between the surface of this ceramic member, and a mold wall, and ] a joint from said molten metal inlet
[Claim 3] A manufacture method of a metal-ceramic compound member according to claim 1 or 2 characterized by making an oxygen density 1% or less in said mold ambient atmosphere substitute production process.
[Claim 4] A manufacture method of a metal-ceramic compound member according to claim 1 to 3 characterized by making pouring temperature into 700-800 degrees C in said teeming production process.
[Claim 5] A manufacture method of a metal-ceramic compound member according to claim 1 to 4 characterized by making virtual junction temperature into 550-750 degrees C in said cementation production process.
[Claim 6] A manufacture method of a metal-ceramic compound member according to claim 1 to 5 characterized by performing actuation which lowers temperature in said mold to virtual junction temperature in said cementation production process so that it may turn to the upper part from said mold pars basilaris ossis occipitalis and temperature may fall gradually.
[Claim 7] A manufacture method of a metal-ceramic compound member according to claim 1 to 6 characterized by said metal being the alloy which uses aluminum or aluminum as a principal component.
[Claim 8] A manufacture method of a metal-ceramic compound member according to claim 1 to 7 that said ceramic member is characterized by being an oxide of aluminum, a nitride, carbide, an oxide of silicon, a nitride, or carbide.
[Claim 9] A manufacturing installation of a metal-ceramic compound member which joins a metal to the surface of a ceramic member according to direct cementation force in a mutual interface of ceramics and a metal by pouring in and carrying out the cooling solidification of the molten metal of a metal which is characterized by providing the following, and which should hold a ceramic member in mold and should be joined into this mold so that the surface of said ceramic member may be contacted The mold ambient atmosphere substitute section which has an ambient atmosphere substitute means which replaces an ambient atmosphere in said mold in said mold where a ceramic member is held, and makes an oxygen density below a predetermined value The preheating section which has a temperature control means to heat beforehand mold after performing mold ambient atmosphere substitute in this mold ambient atmosphere substitute

section A temperature control means to maintain temperature in mold which preheated in this preheating section to pouring temperature A teeming means which carries out teeming of said metal molten metal into this mold so that the inside of this mold may be filled

[Claim 10] A manufacturing installation of a metal-ceramic compound member according to claim 9 to which said mold ambient atmosphere substitute section is characterized by replacing an ambient atmosphere in said mold by inert gas ambient atmosphere.

[Claim 11] A manufacturing installation of a metal-ceramic compound member according to claim 9 or 10 characterized by being that in which said cooling section has a heating means to heat said mold from the side, and a cooling means to cool said mold from a pars basilaris ossis occipitalis.

[Claim 12] When it has the following, a metal molten metal is introduced in mold from said molten metal inlet and said joint is supplied, It is characterized by constituting said joint and a molten metal path so that this metal molten metal may fill the inside of this mold. By holding a ceramic member in mold, pouring in and carrying out the cooling solidification of the molten metal of a metal which should be joined into this mold so that the surface of said ceramic member may be contacted Mold for manufacture used for a manufacture method of a metal-ceramic compound member which joins a metal to the surface of a ceramic member according to direct cementation force in a mutual interface of ceramics and a metal. A molten metal inlet which introduces a metal molten metal in mold A joint which secures a predetermined opening between the surface of this ceramic member, and a mold wall while holding said ceramic member A molten metal path which leads a metal molten metal to a joint from said molten metal inlet A gas drainage hole prepared in the narrow section which removes an oxide skin which was prepared in one location of these molten metal paths, and was formed in the metal molten metal surface, and said joint

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the mold for manufacture at the manufacture method of a metal-ceramic compound member that the ceramics and a metal were firmly joined by the direct cementation force in a mutual interface, a manufacturing installation, and a list.
[0002]
[Description of the Prior Art] The metal-ceramic compound member which employed properties, such as properties, such as the chemical stability of the ceramics, high-melting, insulation, a high degree of hardness, and thermal conductivity high in comparison, metaled high intensity, high toughness and easy-workability, and conductivity, efficiently is widely used for an automobile, an electronic instrument, etc., and the metal-ceramic compound substrate and package the rotor for automobile turbochargers and for large power electronic device mounting are mentioned as the typical example.
[0003] as the main manufacture methods of the above-mentioned metal-ceramic compound member -- adhesion, plating, metallizing, thermal spraying, an insert, a brazing-and-soldering method, and DBC -- DBC using the problem on cost to an alumina substrate about a metal-ceramic compound substrate in recent years although law is well-known -- the metal activity brazing and soldering using law or an alumimium nitride substrate -- most metal-ceramic compound substrates are manufactured more lawfully.
[0004] however, DBC which joins a copper plate directly as a method of joining a metal to an alumina substrate directly in a conventional method -- although law was well-known, the method of joining aluminum directly was not learned until now.
[0005] These people considered as the equipment which joins the aluminum as a metal plate to a ceramic member directly previously, and proposed "the manufacturing installation of a metal-ceramic compound member" to JP,8-198629,A.
[0006] A conveyance means for this equipment to supply a ceramic member continuously, The preheating section which heats the conveyed ceramic member beforehand, and the joint which is made to pass through the inside of the metal molten metal in crucible the ceramic member which it preheated, and joins a metal to a part of perimeter side [ at least ] of a ceramic member, It is possible to manufacture the metal-ceramic compound member which has the property which anneals the joined this ceramic member, was made to solidify a metal, makes the cooling section used as a metal-ceramic compound member with the principal part, and was excellent in large quantities.
[0007]
[Problem(s) to be Solved by the Invention] By the way, although the case where the request which manages the homogeneity of the thickness of this sheet metal very severely was made recently was seen when a sheet metal-like metal was joined to a ceramic member, to such a request, there was a case where it could not necessarily respond fully, with the above-mentioned equipment. Moreover, although development of the ceramic compound substrate which raises a thermolysis property by changing the thickness of a circuit side and a heat sinking plane was also made, in the above-mentioned continuation manufacturing installation, drawing out the compound substrate after cementation straightly needed advanced technology.
[0008] That is, the above-mentioned conventional equipment is structure which supplies a ceramic member horizontally (longitudinal direction) continuously, and is passed in crucible. Therefore, when joining a metal to the 2nd page of the front reverse side of a tabular ceramic member, it moves, while a metal molten metal contacts the member both sides, and joins in the cooling section.
[0009] However, although the pinch roll had pulled the tip horizontally when it was the ceramic compound substrate

with which the thickness of the vertical side of the joined metal differs, it became clear that there may be orientation at which it turns in the thick direction of the joined metal side, and advanced technology was needed for performing continuous manufacture smoothly by this.

[0010] This invention is made under an above-mentioned background, and aims at providing with the mold for manufacture the manufacture method for making it possible to manufacture the various metal-ceramic compound members which have the especially excellent cementation property by low cost, a manufacturing installation, and a list.

[0011]

[Means for Solving the Problem] A manufacture method of invention of claim 1 by holding a ceramic member in mold, pouring in and carrying out the cooling solidification of the molten metal of a metal which should be joined into this mold so that the surface of said ceramic member may be contacted Where a ceramic member is held in mold according to direct cementation force in a mutual interface of ceramics and a metal in a manufacture method of a metal-ceramic compound member which joins a metal to the surface of a ceramic member A mold ambient atmosphere substitute production process which replaces an ambient atmosphere in mold and makes an oxygen density below a predetermined value, A preheating production process which heats mold beforehand after this production process, and a teeming production process which maintains temperature in mold to pouring temperature after this production process, and carries out teeming of the metaled molten metal into mold so that the inside of this mold may be filled, It is characterized by having lowered to virtual junction temperature with which a metaled molten metal begins to solidify temperature in mold, and a cementation operation is demonstrated after this production process, and having a cementation production process which joins a metal to the surface of a ceramic member, and an annealing production process which anneals mold after this production process.

[0012] A manufacture method of invention of claim 2 is said teeming production process in claim 1. As said mold, it has a molten metal inlet which introduces a metal molten metal in this mold, and a joint which secures a predetermined opening between the surface of a ceramic member, and a mold wall while holding a ceramic member. And it is characterized by supplying a metal molten metal after it performed teeming using what has the narrow section which removes an oxide skin formed in the metal molten metal surface in the middle of a path to a joint from a molten metal inlet and an oxide skin was removed by said joint by the narrow section.

[0013] A manufacture method of invention of claim 3 is characterized by making an oxygen density 1% or less at said mold ambient atmosphere substitute production process in claims 1 or 2.

[0014] A manufacture method of invention of claim 4 is characterized by pouring temperature in said teeming production process being 700-800 degrees C in either of claims 1-3.

[0015] A manufacture method of invention of claim 5 is characterized by virtual junction temperature in said cementation production process being 550-750 degrees C in either of claims 1-4.

[0016] A manufacture method of invention of claim 6 is characterized by performing actuation which lowers temperature in mold to virtual junction temperature in said cementation production process so that it may turn to the upper part from a mold pars basilaris ossis occipitalis and temperature may fall gradually in either of claims 1-5.

[0017] A manufacture method of invention of claim 7 is characterized by being the alloy with which said metal uses aluminum or aluminum as a principal component in either of claims 1-6.

[0018] A manufacture method of invention of claim 8 is characterized by said ceramic member being an oxide of aluminum, a nitride, carbide, an oxide of silicon, a nitride, or carbide in either of claims 1-7.

[0019] By a manufacturing installation of invention of claim 9 holding a ceramic member in mold, and pouring in and carrying out the cooling solidification of the molten metal of a metal which should be joined into this mold so that the surface of said ceramic member may be contacted In a manufacturing installation of a metal-ceramic compound member which joins a metal to the surface of a ceramic member according to direct cementation force in a mutual interface of ceramics and a metal The mold ambient atmosphere substitute section which has an ambient atmosphere substitute means which replaces an ambient atmosphere in mold in mold where a ceramic member is held, and makes an oxygen density below a predetermined value, The preheating section which has a temperature control means to heat beforehand mold after performing mold ambient atmosphere substitute in this mold ambient atmosphere substitute section, The teeming section which has a teeming means which carries out teeming of the metal molten metal into a temperature control means to maintain temperature in mold which preheated in this preheating section to pouring temperature, and mold so that the inside of this mold may be filled, It is characterized by having a cooling joint which it lowers [ joint ] to virtual junction temperature with which a metal molten metal begins to solidify temperature in mold by which teeming was carried out in this teeming section, and a cementation operation is demonstrated, and joins a metal to ceramics, and the annealing section which anneals said mold.

[0020] A manufacturing installation of invention of claim 10 is characterized by said mold ambient atmosphere

substitute section replacing an ambient atmosphere in mold by inert gas ambient atmosphere in claim 9.
[0021] A manufacturing installation of invention of claim 11 is characterized by being that in which said cooling section has a heating means to heat mold from the side, and a cooling means to cool mold from a pars basilaris ossis occipitalis in claims 9 or 10.
[0022] Mold for manufacture of invention of claim 12 by holding a ceramic member in mold, pouring in and carrying out the cooling solidification of the molten metal of a metal which should be joined into this mold so that the surface of said ceramic member may be contacted In mold for manufacture used for a manufacture method of a metal-ceramic compound member which joins a metal to the surface of a ceramic member according to direct cementation force in a mutual interface of ceramics and a metal A molten metal inlet which introduces a metal molten metal in mold, and a joint which secures a predetermined opening between the surface of this ceramic member, and a mold wall while holding said ceramic member, A molten metal path which leads a metal molten metal to a joint from said molten metal inlet, and the narrow section which removes an oxide skin which was prepared in one location of these molten metal paths, and was formed in the metal molten metal surface, When it has a gas drainage hole prepared in said joint, a metal molten metal is introduced in mold from said molten metal inlet and said joint is supplied, it is characterized by constituting said joint and a molten metal path so that this metal molten metal may fill the inside of this mold.
[0023] According to the above-mentioned configuration, a mold ambient atmosphere substitute production process which replaces an ambient atmosphere in mold in mold where a ceramic member is held, and makes an oxygen density below a predetermined value is performed. Next, perform a preheating production process which heats mold beforehand, and then temperature in mold is maintained to pouring temperature. A teeming production process which carries out teeming so that a metaled molten metal may be moved towards the side else from 1 side into mold, a metal molten metal contacting the ceramic surface and the inside of mold may be filled one by one is performed. Next, by lowering to virtual junction temperature with which a metaled molten metal begins to solidify temperature in mold, and a cementation operation is demonstrated, performing a cementation production process which joins a metal to the surface of a ceramic member, and having been made to perform an annealing production process which anneals mold next While being able to strengthen extremely direct cementation force in an interface of ceramics and a metal for example, like [ in a case of joining a metallic thin plate as a circuit side, and a metallic thin plate as a heat sinking plane to both sides of a ceramic substrate ] Also when joining a metallic thin plate with which thickness differs mutually to both sides, a metallic thin plate of highly precise and uniform thickness can be easily joined by making precision of mold suitable. And in a preheating production process, a teeming production process, and a cementation production process, since he is trying to set it as a suitable temperature respectively, there is also no possibility of excessive thermal stress not joining a ceramic member, therefore damaging with thermal stress.
[0024] Furthermore, it has as mold a molten metal inlet which introduces a metal molten metal in mold, and a joint which secures a predetermined opening between the surface of a ceramic member, and a mold wall while holding a ceramic member. It is made to perform a teeming production process using what has the narrow section which removes an oxide skin formed in a location of either of the paths to a joint from a molten metal inlet on the metal molten metal surface. By supplying only a pure metal molten metal from which an oxide film was removed to a joint, it makes it possible to acquire firmer cementation force.
[0025] Even if this invention contacts a metal molten metal on the ceramic surface, cementation force is based on discovery by this invention persons that cementation force is acquired, when it is made to contact under specific conditions and solidifies to the conventional common sense of not being obtained. Although not yet solved fully about a mechanism from which this cementation force is acquired, the above-mentioned specific conditions are acquired by trial and error by this invention persons.
[0026] Namely, advantageous, when acquiring cementation force with the firm one where an oxygen density of an ambient atmosphere of the perimeter is possible as low as a joint in the case of cementation, It is advantageous, when acquiring cementation force with that it is advantageous to carry out relative displacement of the ceramic surface and the metal molten metal, to contact them as both are rubbed, and to make it join when acquiring firmer cementation force, and firm [ as for a metal molten metal to contact ] an oxide skin being removed etc.
[0027] As a metal used by this invention, an alloy which uses aluminum or aluminum as a principal component can be used. Moreover, an oxide of aluminum or silicon, a nitride, carbide, etc. can be used as a ceramic member used by this invention.
[0028] according to such combination -- both sides of for example, a ceramic substrate -- a circuit -- a field -- a metallic thin plate -- a heat sinking plane -- when a substrate for power modules which joined a metallic thin plate is constituted, a differential thermal expansion of an aluminum and a ceramic substrate by pyrexia of a power module is comparatively large, but since reinforcement of aluminum is low, what has few cementation deterioration by heat expansion difference

can be obtained.
[0029]
[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained based on a drawing. Drawing in which drawing 1 shows the configuration of the manufacturing installation of a metal-ceramic compound member, drawing 2 - drawing 6 are the block diagrams of mold, and the decomposition plan of the mold which looked at drawing 2 in the perspective diagram of the mold for manufacture, and looked at drawing 3 in the direction of an III-III view of drawing 2 , and drawing 4 are [ the V-V view cross section of drawing 2 and drawing 6 of IV-IV view drawing of drawing 2 and drawing 5 ] the VI-VI view cross sections of drawing 2 .
[0030] This manufacturing installation manufactures a metal-ceramic compound member by holding ceramic substrate K [referring to [ drawing 3 and ] drawing 6 (b)] inside this mold 10, and contacting a metal molten metal to that perimeter using the mold 10 of a special configuration. The ambient atmosphere substitute section 1 to which this manufacturing installation adjusts the ambient atmosphere in mold 10 to the inert gas ambient atmosphere conditions of 1% or less of oxygen densities as shown in drawing 1 (ambient atmosphere substitute means), The preheating section 2 which heats beforehand the mold 10 after replacing an ambient atmosphere in the ambient atmosphere substitute section 1, The temperature in the mold 10 which preheated in this preheating section 2 is maintained to pouring temperature. In mold 10 in the condition a metal molten metal The teeming section 3 which carries out teeming so that it may move towards the side else from 1 side and the inside of mold may be filled one by one, a metal molten metal contacting the surface of a ceramic member, It consists of a cooling joint 4 which it lowers [ joint ] to the virtual junction temperature with which a metal molten metal begins to solidify the temperature in the mold 10 by which teeming was carried out in this teeming section 3, and a cementation operation is demonstrated, and joins a metal to the ceramics, and the annealing section 5 which anneals said mold 10.
[0031] These ambient atmosphere substitute section 1, the preheating section 2, the teeming section 3, the cooling joint 4, and the annealing section 5 are horizontally located in a line with the serial, and the shutters 6A, 6B, and 6C for electric shielding are formed between the cooling section 4 and the annealing section 5 between the teeming section 3 and the cooling section 4 between the ambient atmosphere substitute section 1 and the preheating section 2. Moreover, in the side wall of the preheating section 2, the teeming section 3, and the cooling section 4, the heaters 8A, 8B, and 8C as a heating means and a temperature control means are formed, and the temperature of the mold 10 held indoors can be appropriately controlled now on it. Especially, the water cooled jacket 9 as a cooling means is arranged on the cooling joint 5 so that mold 10 can be cooled from a pars basilaris ossis occipitalis. In addition, in the teeming section 3 of drawing 1 , it is linear DOMOTA which is shown with the sign 21 attached in mold 10, and 22 is a piston made from a graphite. These are equivalent to a teeming means.
[0032] Next, the mold 10 produced with the graphite is explained. The mold 10 used here makes mold board 10B of the mold boards 10A and 10A on a side front and a background, and a center three-sheet doubling, joins together, and enables it to make the circuit board (metal-ceramic compound member) of four sheets at once, as shown in drawing 2 and drawing 3 . Drawing 4 shows the configuration of the internal surface of mold board 10A on a side front and a background, and drawing 5 shows the configuration of both the wall surfaces of central mold board 10B.
[0033] These mold boards 10A and 10B have the hollows 11A, 11B, 13A, 13B, 14A, and 14B of a predetermined configuration, and form the impregnation cylinder fixed part 11 as a molten metal inlet, the molten metal installation path 13, and the joint 14 by being combined as mold 10. The molten metal impregnation cylinder fixed part 11 is arranged in the center section of mold 10, the molten metal installation path 13 is horizontally developed so that it may branch from the lower part, and each joint 14 is formed so that it may be open for free passage at the tip of each molten metal installation path 13. The space as a joint 14 is formed in bilateral symmetry two pieces on both sides of the molten metal impregnation cylinder fixed part 11 while it is formed in front reverse side both sides of central mold board 10B. Therefore, it is by four all.
[0034] Moreover, the narrow section 12 which is located in the boundary of the molten metal impregnation cylinder fixed part 11 and the molten metal installation path 13, and opens both for free passage is formed in the mold 10 which consists of three mold boards 10A, 10A, and 10B, the crevice 16 for ceramic member immobilization is formed in it in the form where a central field laps with a joint 14, and the gas drainage hole 15 is formed in it so that it may be open for free passage in the upper part of a joint 14. The relation between the crevice 16 for ceramic member immobilization and a joint 14 is the internal surface of a joint 14, and the relation which can secure the predetermined opening 29 between the ceramic members K, when mold 10 is closed where the ceramic member K is inserted in the crevice 16 for ceramic member immobilization as shown in drawing 6 (b).
[0035] Moreover, the narrow section 12 is a part which removes the oxide skin of the metal molten metal surface poured in from the molten metal impregnation cylinder fixed part (equivalent to a molten metal inlet) 11, and is formed in the

aperture (for example, 1mm or less, preferably 0.8mm or less) of the degree which does not allow passage of an oxide skin. The metal molten metal after the oxide skin was removed by the narrow section 12 goes into the perpendicular space of the molten metal installation path 13, is introduced into the pars basilaris ossis occipitalis of a joint 14 through the level space of the molten metal installation path 13 from there, moves and goes toward the upper part from the pars basilaris ossis occipitalis of a joint 14, and contacts the surface of the ceramic member K held in the crevice 16 for ceramic member immobilization in the meantime. Therefore, after being injected into the molten metal impregnation cylinder fixed part 11, once a metal molten metal falls caudad, the path of a molten metal is constituted, moving up so that it may contact and go to the ceramic member K.

[0036] In addition, the concavo-convex sections 19A and 19B which fit in in case it joins together mutually, and position the mold boards 10A and 10A and both 10B are formed in the periphery section of the mold boards 10A, 10A, and 10B.

[0037] Next, how to make the target compound member using above-mentioned mold 10 and an above-mentioned manufacturing installation is explained. Here, the mold 10 which unified the mold boards 10A and 10A of the front reverse side by coalescing in central mold board 10B by preparing four 62mmx112mmx0.635mm alumina-ceramics substrates, and inserting these substrates K in the crevice 16 for ceramic member immobilization of the mold boards 10A and 10B of the front reverse side as shown in drawing 3 is first made as a ceramic member K. Subsequently, the oxygen density in mold 10 is preferably set to 0-500 ppm 1% or less by installing this mold 10 in the ambient atmosphere substitute section 1, and making nitrogen gas flow in the furnace of the ambient atmosphere substitute section 1 (ambient atmosphere substitute production process).

[0038] Subsequently, mold 10 is moved to the preheating section 2, and the temperature up of the mold 10 is carried out from a room temperature to 800 degrees C by heater 8A in this preheating section 2 in 1 hour (beforehand a heat process degree). in this case, the ceramic member K in mold 10 does not break -- as -- a temperature up -- it carries out -- it can kick, and if it is **, there is nothing.

[0039] Subsequently, the mold 10 which preheated is moved to the impregnation section 3, and the piston 22 made from a graphite and linear DOMOTA 11 are set to the molten metal impregnation cylinder fixed part 11 of the upper part of mold 10. after [ and ] breaking ********** of aluminum by pushing in an aluminum molten metal in mold 10 (pushing force being 70kgMAX(s)), and passing the narrow section 12 by pressurizing the piston 22 made from a graphite by linear DOMOTA 21, where an aluminum molten metal (metal molten metal) is poured into mold 10 -- pure -- only a **** aluminum molten metal is supplied to the molten metal installation path 13 below the narrow section 12. It is good to pour in an aluminum molten metal into mold 1 so that an aluminum molten metal may move at the speed of 1000 or less mm/min in a ceramic substrate top.

[0040] Thus, if an aluminum molten metal is stuffed into the molten metal installation path 13, an aluminum molten metal is introduced into the pars basilaris ossis occipitalis of a joint 14 from the molten metal installation path 13, and up will go so that it may face across both sides of the ceramic substrate fixed to the crevice 16 for ceramic member ****, and it will reach the upper limit (molten metal reservoir section) of a joint 14 (teeming production process). Actuation of linear DOMOTA 21 is stopped in the place to which the part of these escaped from and came out of the gas drainage hole 15.

[0041] In the case of this teeming production process, whenever [ furnace temperature / of the teeming section 3 ] is adjusted to 700-850 degrees C by heater 8B. This is because fluidity nature worsens, it will react to reverse with mold ****** if it is 850 degrees C or more, and a mold detached building worsens below 700 degrees C since the melting point of aluminum is 660 degrees C.

[0042] If the above-mentioned teeming production process is completed, mold 10 will be moved to the cooling joint 4, it cools with the lower water cooled jacket 9, heating by heater 8C of both walls in the cooling joint 4, and applying a 3-5 degrees C [ per cm ] temperature gradient in the height direction from the lower part of mold 10, it will cool slowly over 30 minutes to 600 degrees C, and aluminum will be joined to a ceramic substrate (cementation production process).

[0043] Next, after taking out mold 10 in the annealing section 5 and carrying out **** (annealing production process) to near the room temperature temperature, mold 10 is taken out outside, the aluminum alumina-ceramics compound member of four sheets is taken out from mold 10, and an activity is completed.

[0044] Thus, the obtained aluminum alumina-ceramics compound member showed the uniform field which does not have a shrinkage cavity etc. in the aluminum surface.

[0045] In addition, also when same processing was performed using an alumimium nitride member and a silicon nitride member as a ceramic member, the compound member which shows the uniform field which does not have a shrinkage cavity etc. similarly was obtained.

[0046]

[Effect of the Invention] As explained above, while being able to strengthen extremely the direct cementation force in the interface of the ceramics and a metal according to this invention, a compound substrate without a shrinkage cavity etc. can be manufactured with the sufficient yield. Also when joining the metallic thin plate with which thickness differs mutually to both sides like [ in the case of following, for example, joining the metallic thin plate as a circuit side, and the metallic thin plate as a heat sinking plane to both sides of a ceramic substrate ], the metallic thin plate of highly precise and uniform thickness can be easily joined by making precision of mold suitable. Moreover, by setting mold as a suitable temperature in each production process, such as a preheating production process, and a teeming production process, a cementation production process, it can avoid that excessive thermal stress joins a ceramic member, and a possibility of damaging with thermal stress can be abolished. Moreover, the narrow section which removes an oxide skin is prepared in the interior of mold, and if only the pure metal molten metal from which the oxide film was removed is supplied to a joint, the firmer cementation force can be acquired. Therefore, it becomes possible to manufacture the various metal-ceramic compound members which have the outstanding cementation property to low cost.

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DRAWINGS

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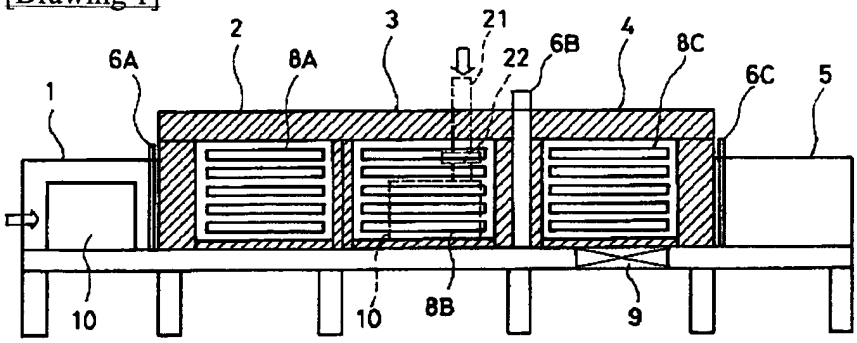
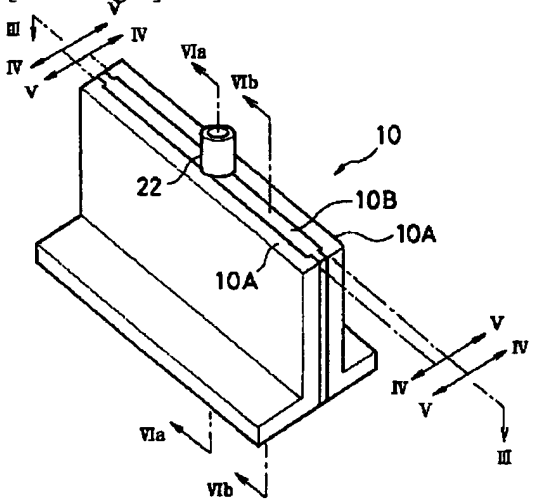
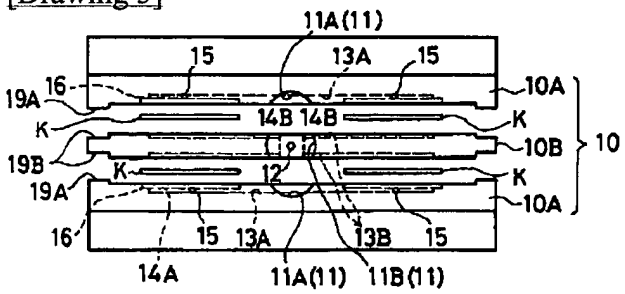
[Drawing 1]



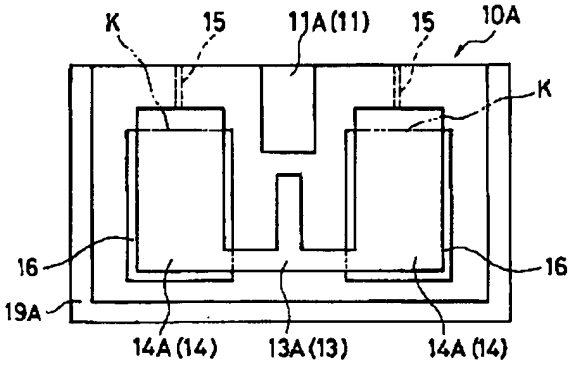

[Drawing 2]



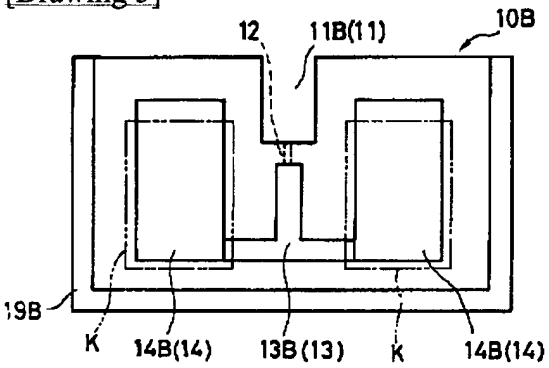

[Drawing 3]



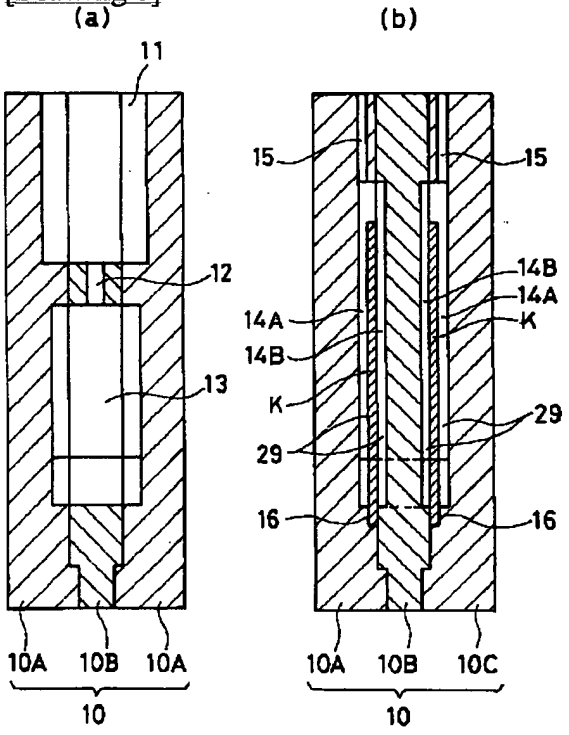

[Drawing 4]




[Drawing 5]




[Drawing 6]

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[Translation done.]